

SECTION 16460

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

Edit A and B to match Project requirements.

- A. Dry-type transformers for general purpose loads.
- B. Dry-type transformers for non-linear loads

1.2 QUALITY ASSURANCE

- A. Conform to requirements of ANSI/NFPA 70 - *National Electrical Code*.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purposes specified and shown.

1.3 SUBMITTALS

- A. Provide the following submittals according to the requirements of Sections 01300 and 01700.
 - 1. Catalog Data. Include outline and support point dimensions of transformer enclosures and accessories, unit weight, voltages, kVA, impedance, sound level, tap configurations, insulation system type, and rated temperature rise.
 - 2. Certifications signed by manufacturers certifying that their products comply with the specified requirements.
 - 3. Operation and maintenance instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Cover transformer ventilating openings to keep out dust. Store in a warm dry location with uniform temperature or apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated type transformer.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 PRODUCTS

2.1 DRY TYPE TRANSFORMERS - GENERAL PURPOSE

- A. Provide factory assembled and tested, air cooled, two-winding type, dry-type transformers with voltage and kVA ratings as indicated on the Drawings. Transformers shall be UL 1561 listed and shall be manufactured and tested according to the following standards:
 - 1. NEMA ST20—*Dry Type Transformers for General Applications*.

2. ANSI/IEEE C57.12.01—*IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers.*
 3. ANSI/IEEE C57.12.91—*IEEE Standard Test Code for Dry-Type Distribution and Power Transformers.*
- B. Transformer insulating materials shall be according to NEMA ST20 Standards for a 220 °C UL component recognized insulation system.
 - C. Transformers 15 kVA and larger shall be 115 °C temperature rise above 40 °C ambient at 7500 ft. altitude. Transformers shall be capable of carrying a 15% continuous overload without exceeding a 150 °C rise in a 40 °C ambient at 7500 ft. altitude.
 - D. Transformer coils may be aluminum or copper with continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish. Terminations shall be brazed or welded to the coil conductor.
 - E. Transformers 15 kVA and larger shall have a minimum of two 2½% full capacity above normal (FCAN) and four 2½% full capacity below normal (FCBN) primary taps.
 - F. Furnish transformers with increased air spacings, using factors in ANSI/IEEE C57.12.01, to obtain adequate air dielectric strength at an altitude of 7500 ft.
 - G. Transformer cores shall be constructed of a high grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below the saturation point. The core laminations above 112.5 kVA shall be miter cut at the core corners to reduce hot spots, core loss, excitation current and sound level. The core laminations shall be clamped with steel angles. Cores for transformers greater than 300 kVA shall be clamped utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core. The completed core and coil shall then be bolted to the base of the enclosure but isolated by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and the enclosure. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.
 - H. The core of the transformer shall be visibly grounded to the enclosure by a flexible grounding conductor sized following applicable UL and NEC Standards.
 - I. The transformer enclosure shall be ventilated and shall be fabricated of a heavy gauge, sheet steel construction. The entire enclosure shall be finished using a process consisting of degreasing, cleaning and phosphatizing followed by finish coatings and baking cycle to provide a uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be light or medium grey.
 - J. The maximum temperature of the top of the enclosure shall not exceed 50 °C rise above a 40 °C ambient.

Edit K to match Project requirements; some installations may require lower sound levels

- K. Maximum sound levels shall not exceed those specified in ANSI/NEMA ST20 when factory tested according to IEEE Standard C57.12.91.
- L. Provide nameplate indicating transformer connection data and overload capacity based on rated allowable temperature rise.

- M. Transformers 45 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 45 KVA shall be suitable for floor or trapeze mounting. Provide mounting accessories for installations indicated on the Drawings.

Edit N to match Project requirements.

- N. Provide weathershields for transformers installed outdoors.
- O. Manufacturers: Square D "WATCHDOG", Cutler-Hammer/Westinghouse, Heavi-Duty, Siemens, General Electric.

Use 2.2 on projects with separately derived systems for computer or other high harmonic loads.

2.2 DRY TYPE TRANSFORMERS FOR NON-LINEAR LOADS

- A. Provide factory assembled and tested, air cooled, two-winding type, dry-type transformers with voltage, kVA and K-factor ratings as indicated on the Drawings. Transformers shall be UL 1561 listed and shall be manufactured and tested according to the following standards:
1. NEMA ST20 — *Dry Type Transformers for General Applications.*
 2. ANSI/IEEE C57.12.01 — *IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers.*
 3. ANSI/IEEE C57.12.91 — *IEEE Standard Test Code for Dry-Type Distribution and Power Transformers.*
 4. ANSI/IEEE C57.110 — *IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents.*
- B. Transformer insulating materials shall be according to NEMA ST20 Standards for a 220°C UL component recognized insulation system.
- C. Transformers shall be 115°C temperature rise above 40 °C ambient at 7500 ft. altitude. Neither the primary nor the secondary temperature shall exceed 220°C at any point in the coils while carrying their full rating of non-sinusoidal loads. K-factors shall be defined as the sum of fundamental and harmonic $I(pu)^2h^2$ per ANSI/IEEE C57.110-1986. The rating of K-factors by average temperature rise alone shall not be acceptable.
- D. Transformer coils may be aluminum or copper with continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish. Terminations shall be brazed or welded to the coil conductor.
- E. Size transformer neutral terminal for 200% of the rated secondary phase current.
- F. Transformers 15 kVA and larger shall have a minimum of two 2½% full capacity above normal (FCAN) and four 2½% full capacity below normal (FCBN) primary taps.
- G. Furnish transformers with increased air spacings, using factors in ANSI/IEEE C57.12.01, to obtain adequate air dielectric strength at an altitude of 7500 ft.

- H. Transformer core shall be constructed of a high grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below the saturation point to prevent core overheating caused by harmonic voltage distortion.
- I. Transformers shall be common core construction. The core laminations above 112.5 kVA shall be miter cut at the core corners to reduce hot spots, core loss, excitation current and sound level. The core laminations shall be clamped with steel angles. Cores for transformers greater than 300 kVA shall be clamped utilizing insulated bolts through the core laminations to provide proper pressure throughout the length of the core. The completed core and coil shall then be bolted to the base of the enclosure but isolated by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.
- J. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized according to applicable UL and NEC Standards.
- K. The transformer enclosure shall be ventilated and shall be fabricated of a heavy gauge, sheet steel construction. The entire enclosure shall be finished using a process consisting of degreasing, cleaning and phosphatizing followed by finish coatings and baking cycle to provide a uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be light or medium grey.
- L. The maximum temperature of the top of the enclosure shall not exceed 50 °C rise above a 40 °C ambient.
- M. Transformers shall be supplied with a full width electrostatic shield resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
 - 1. Common Mode: 0 to 1.5Hz - 120db; 1.5 to 10kHz - 90db; 10 to 100kHz - 65db; 100kHz to 1MHz - 40db.
 - 2. Traverse Mode: 1.5 to 10kHz - 52db; 10 to 100kHz - 30db, 100kHz to 1MHz - 30db.

Edit N to match Project requirements; some installations may require lower sound levels

- N. Maximum sound levels shall not exceed those specified in ANSI/NEMA ST20 when factory tested according to IEEE Standard C57.12.91.
- O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
- P. Transformers 45 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 45 KVA shall be suitable for floor or trapeze mounting. Provide mounting accessories for installations indicated on the Drawings.

Edit Q to match Project requirements.

- Q. Provide weathershields for transformers installed outdoors.
- R. Manufacturer: Square D "NL and NLP Series", Cutler-Hammer/Westinghouse, Heavi-Duty, Siemens, General Electric.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set transformers plumb and level.
 - 1. Install floor-mounted transformers on 4 inch high reinforced concrete pads. Secure transformers to pad using not less than four 1/2 inch diameter, 3 inches long, anchor bolts.
 - 2. Install wall-mounted transformers on wall brackets manufactured by the transformer manufacturer. Do not mount transformers larger than 15 kVA on drywall construction. Secure brackets to masonry or concrete wall using not less than four 1/2 inch diameter, 3 inches, long anchor bolts. Do not wall mount transformers larger than 45 kVA.
- B. Arrange equipment to provide adequate spacing for access and for cooling air circulation as follows:

Transformer kVA	Minimum separation from back wall.	Minimum separation from ceiling or adjacent wall (or similar obstruction).
15 kVA	3 inches	3 inches
30 kVA	3 inches	6 inches
45 kVA	3 inches	9 inches
75 kVA	4 inches	15 inches
112.5 kVA	5 inches	24 inches
150 kVA	6 inches	24 inches
225 kVA	7 inches	24 inches
300 kVA	10 inches	24 inches
500 kVA	14 inches	24 inches

- C. Do not locate transformers above heat-producing equipment.
- D. Use flexible conduits, 2 ft. minimum lengths, for connections to transformer case. Make conduit connections to transformer enclosure only at locations designated by the manufacturer's installation instructions.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A.
- F. Ground transformers and systems served by transformers according to Section 16450 - SECONDARY GROUNDING.

- G. Identify transformers and install warning signs according to Section 16195 - ELECTRICAL IDENTIFICATION.

3.2 FIELD QUALITY CONTROL

- A. Inspect accessible components for cleanliness, mechanical, and electrical integrity, for presence of damage or deterioration, and to ensure removal of temporary shipping bracing before energizing transformers.
- B. Measure primary and secondary voltages and make appropriate tap adjustments after normal operating loads have been energized. Adjust taps to provide the following voltage at points of use; record voltages and tap settings.

<u>System Nominal Voltage</u>	<u>Minimum Load Voltage</u>
480Y/277	460Y/265
208Y/120	200Y/115
120/240	115/230

- C. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

END OF SECTION